

REMARKS

The forgoing amendment amends claims 1, 7-8, 11-13, 19, 23 and 25-27, cancels claim 24 and adds claims 28-29. Now pending in the application are claims 1-20, 22-23 and 25-29, of which claims 1, 9, 13 and 27 are independent. Applicants respectfully submit that the pending claims define over the prior art of record.

I. Summary of Rejections

Claims 7-8, 11-12, 19-20 and 27 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite.

Claims 1, 2, 4, 6, 13-17, 23 and 25-27 are rejected under 35 U.S.C. §102(b) as being anticipated by, or under 35 U.S.C. §103(a) as being unpatentable over, U.S. Patent No. 5,290,642 (“Minh-I”).

Claims 1, 4, 5, 13-17, 23 and 25-27 are rejected under 35 U.S.C. §102(b) as being anticipated by, or under 35 U.S.C. §103(a) as being unpatentable over, U.S. Patent No. 5,256,499 (“Minh-II”).

Claims 23, 25 and 26 are rejected under 35 U.S.C. §102(b) as being anticipated by or, in the alternative, under 35 U.S.C. §103(a) as being unpatentable over, JP 5-101838.

Claims 2, 3, 18 and 24 are rejected under 35 U.S.C. §103(a) as being unpatentable over Minh-I in view of U.S. Patent Application Publication No. 2002/0081475 (“Simpkins”).

Claim 7 is rejected under 35 U.S.C. §103(a) as being unpatentable over Minh-I in view of U.S. Patent Application Publication No. 2004/0017028 (“Olsen”).

Claim 14 is rejected under 35 U.S.C. §103(a) as being unpatentable over Minh-I in view of U.S. Patent No. 4,913,982 (“Kotchick”).

Claims 1, 8, 13, 15, 16, 19 and 23 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,882,809 (“McPheeters”) in view of Minh-I.

Claims 1 and 8 are rejected under 35 U.S.C. §103(a) as being unpatentable over McPheeters in view of U.S. Patent Application Publication No. 2005/0019636 (“Kwon”).

Claims 9, 11 and 12 are rejected under 35 U.S.C. §103(a) as being unpatentable over Minh-I in view of JP 9-190829.

Claims 1, 2, 4, 9-11, 13, 15, 16, 22, 23, 25 and 27 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Application Publication No. 2003/0077498 (“Cable”) in view of Minh-I.

Claims 13-16, 19, 20, 22, 23 and 25-27 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,857,420 (“Maricle”) in view of Minh-I.

The rejection will be discussed separately.

II. Claim Rejections under 35 U.S.C. §112, Second Paragraph

Claims 7-8, 11-12, 19-20 and 27 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite. (Office Action, page 2). Claims 7-8, 11-12, 19 and 27 are amended as suggested by the Examiner to address insufficient antecedent basis issues. No new matter is added. Applicants, therefore, request that the 35 U.S.C. §112, second paragraph rejections of claims 7-8, 11-12, 19-20 and 27 be withdrawn.

III. Claim Rejections over Minh-I

Claims 1, 2, 4, 6, 13-17, 23 and 25-27 are rejected under 35 U.S.C. §102(b) as being anticipated by, or under 35 U.S.C. §103(a) as being unpatentable over Minh-I. (Office Action, page 3). Applicants respectfully traverse this rejection.

Independent claim 1 recites:

1. A method of forming an interconnector component for an electrochemical converter, comprising the steps of:
casting a first slurry into a layer to form a first tape;
casting a second slurry into a layer to form a second tape;
laminating the first tape to the second tape to form a laminated structure; and
hot pressing the laminated structure using a combination of heat and pressure to form the interconnector component that contains chromium.

Independent claim 13 recites:

13. A method of forming a high density interconnector component for an electrochemical converter, comprising the steps of:
tape casting a slurry material into a sheet; and
applying heat and pressure to sinter the sheet to form the interconnector component that contains chromium.

Independent claim 27 recites:

27. A method of forming a high density thin interconnector plate for a electrochemical converter, comprising the steps of:
tape casting a slurry material into a sheet; and
applying heat and pressure to sinter the sheet to a thickness of less than about 0.03 inches to form an interconnector component that contains chromium.

Applicants respectfully submit that Minh-I does not disclose or teach “***hot pressing the laminated structure using a combination of heat and pressure to form the interconnector component that contains chromium,***” as recited in claim 1, “***applying heat and pressure to sinter the sheet to form the interconnector component that contains chromium,***” as recited in claim 13, and “***applying heat and pressure to sinter the sheet to a thickness of less than about 0.03 inches to form an interconnector component that contains chromium,***” as recited in claim 27.

Claims 1, 13 and 27 are directed to a method for forming an interconnector component in a fuel cell construction. In the conventional techniques, tape cast was considered unsuitable for the fabrication of a chromium interconnector. The present application solves the problem of

forming chromium sheets from tape cast green. To achieve high density impermeable structure required for fuel cell operation, the present application uses hot press sintering following the tape cast process. The present application is capable of producing a thinner chromium sheet at lower cost, and thus reducing the production cost. In an exemplary embodiment, the pressure may be in a range of about 1000 psi, as recited in new claim 28, and the temperature may be in a range of about 1300°C, as recited in new claim 29.

Minh-I discloses a method of fabricating a monolithic solid oxide fuel cell. Minh-I discloses tape casting and heat processing using heat. (See Minh-I, column 6, lines 9-66, and column 7, lines 31-56).

The Examiner refers to Minh-I, col. 8, lines 39-43 as disclosing the above feature of the claimed invention. Applicants respectfully disagree.

Minh-I, at column 8, lines 39-43, recites:

It should be noted that during the assembly of the sintered subassemblies into the stacked monolith and during the heat treating of the monolith, a compressive force may be applied to promote contact and interbonding at the adjacent surfaces.

In this portion, Minh-I discloses that the compressive force may be applied to assemble the subassemblies into a fuel cell stack. In Minh-I, the “compressive force” may *promote contact* between the surfaces of the subassemblies in the fuel cell stack. Minh-I does not disclose that the “compression force” is used to achieve a *high density* by pressing out the flow passage voids in a monolithic structure. Minh-I does not disclose or teach using the combination of heat and pressure to form the interconnector component for an electrochemical converter, which contains *chromium*.

Furthermore, there is no disclosure in Minh-I that hot pressing is used in combination with *tape casting* to produce an interconnector component that contains chromium.

In view of the foregoing arguments, Applicants respectfully submit that Minh-I does not disclose or teach each and every element of claims 1, 13 and 27. Claims 2, 4, 6 and 14-17,

which depend from one of claims 1 and 13, incorporate the subject matter of one of claims 1 and 13. Therefore, Minh-I does not disclose or teach each and every element of claims 2, 4, 6 and 14-17. Applicants therefore request that the 35 U.S.C. §102(b) or 35 U.S.C. §103(a) rejection of claims 1, 2, 4, 6, 13-17, 23 and 25-27 be withdrawn.

IV. Claim Rejections over Minh-II

Claims 1, 4, 5, 13-17, 23 and 25-27 are rejected under 35 U.S.C. §102(b) as being anticipated by, or under 35 U.S.C. §103(a) as being unpatentable over, Minh-II. (Office Action, page 4). Applicants respectfully traverse this rejection.

Applicants respectfully submit that Minh-I does not disclose or teach “*hot pressing the laminated structure using a combination of heat and pressure to form the interconnector component that contains chromium,*” as recited in claim 1, “*applying heat and pressure to sinter the sheet to form the interconnector component that contains chromium,*” as recited in claim 13, and “*applying heat and pressure to sinter the sheet to a thickness of less than about 0.03 inches to form an interconnector component that contains chromium,*” as recited in claim 27.

Minh-II discloses a method of fabricating a monolithic solid oxide fuel cell with integral manifolds. Minh-II discloses tape casting and partial heat processing using heat. (See Minh-II, column 5, line 28 through column 6, line 15, and column 7, lines 18-46).

The Examiner refers to Minh-II, col. 8, lines 37-41 as disclosing the above feature of the claimed invention. Applicants respectfully disagree.

Minh-II, at column 8, lines 37-41, recites:

It should be noted that during the assembly of the sintered subassemblies into the stacked monolith and during the heat treating of the monolith, a compressive force may be applied to promote contact and interbonding at the adjacent surfaces.

As discussed above, this portion of Minh-II discloses that the compressive force may be applied to assemble the subassemblies into the the stacked monolith. Minh-II, however, does not disclose or teach using the combination of heat and pressure to form the interconnector component for an electrochemical converter, which contains chromium.

In view of the foregoing arguments, Applicants submit that Minh-II does not disclose or teach each and every element of claims 1, 13 and 27. Claims 4, 5, 14-17, 23 and 25-26, which depend from one of claims 1 and 13, incorporate the subject matter of one of claims 1 and 13. Applicants therefore request that the 35 U.S.C. §102(b) or 35 U.S.C. §103(a) rejection of claims 1, 4, 5, 13-17, 23 and 25-27 be withdrawn.

V. Claim Rejections over JP 5-101838

Claims 23, 25 and 26 are rejected under 35 U.S.C. §102(b) as being anticipated by or, in the alternative, under 35 U.S.C. §103(a) as being unpatentable over, JP 5-101838. (Office Action, page 4).

Applicants amend claim 23 to incorporate the subject matter of claim 24. Applicants also amend claims 25 and 26 to depend from claim 23. No new matter is introduced.

Amended claim 23 recites that material forming the interconnector plate has a composition that is at least 95% chromium. JP 5-101838 teaches a green body of thin film made of doped lanthanum chromate with alkali metal. JP 5-101838, however, does not teach or suggest that the interconnector plate has a composition that is at least 95% chromium, as recited in claim 23.

Therefore, JP 5-101838 does not teach or suggest all of the limitations of claim 23. In view of the foregoing amendments, Applicants respectfully request that the 35 U.S.C. §102(b) or 35 U.S.C. §103(a) rejection of claims 23, 25 and 26 be withdrawn.

VI. Claim Rejections over Minh-I in view of Simpkins

Claims 2, 3, 18 and 24 are rejected under 35 U.S.C. §103(a) as being unpatentable over Minh-I in view of Simpkins. (Office Action, page 5). Applicants respectfully traverse this rejection.

Claims 2 and 3 depend upon claim 1 and add separate and patentable limitations. Claim 18 depends upon claim 13 and adds a separate and patentable limitation. Applicants submit that Simpkins does not teach “*hot pressing the laminated structure using a combination of heat and pressure to form the interconnector component that contains chromium,*” as recited in claim 1, and “*applying heat and pressure to sinter the sheet to form the interconnector component that contains chromium,*” as recited in claim 13.

As discussed above, Minh-I does not teach these features. Simpkins is cited by the Examiner to provide teachings for the limitation added in claims 2, 3, 18 and 24. Simpkins teaches a gas diffusion mat for fuel cells. Simpkins, however, does not teach the use of heat and pressure together to form an interconnector component for an electrochemical converter, which contains chromium.

In view of the foregoing arguments, Applicants submit that Minh-I and Simpkins, alone or in any reasonable combination, do not teach all of the limitations of claims 1 and 13. Claims 2, 3, 18 and 24, which depend from one of claims 1 and 13, are not rendered obvious over the cited references. Applicants therefore request that the 35 U.S.C. §103(a) rejection of claims 2, 3, 18 and 24 be withdrawn.

VII. Claim Rejections over Minh-I in view of Olsen

Claim 7 is rejected under 35 U.S.C. §103(a) as being unpatentable over Minh-I in view of Olsen. (Office Action, page 6). Applicants respectfully traverse this rejection.

Claim 7 depends upon claim 1 and adds a separate and patentable limitation. Applicants submit that Olsen does not teach “*hot pressing the laminated structure using a combination of*

heat and pressure to form the interconnector component that contains chromium,” as recited in claim 1.

As discussed above, Minh-I does not teach this feature. Olsen is cited by the Examiner to provide teachings for the limitation added in claim 7. Olsen teaches shaping solid oxide fuel cells (SOFC) and SOFC stacks. Olsen, however, does not teach the use of heat and pressure together to form the sintered structure of a sheet or tape.

In view of the foregoing arguments, Applicants submit that Minh-I and Olsen, alone or in any reasonable combination, do not teach all of the limitations of claim 1. Claim 7, which depends from claim 1, is not rendered obvious over the cited references. Applicants respectfully request that the 35 U.S.C. §103(a) rejection of claim 7 be withdrawn.

VIII. Claim Rejections over Minh-I in view of Kotchick

Claim 14 is rejected under 35 U.S.C. §103(a) as being unpatentable over Minh-I in view of Kotchick. (Office Action, page 7). Applicants respectfully traverse this rejection.

Claim 14 depends upon claim 13 and adds a separate and patentable limitation. Applicants submit that Kotchick does not teach “***applying heat and pressure to sinter the sheet to form the interconnector component that contains chromium,***” as recited in claim 13.

As discussed above, Minh-I does not teach this feature. Kotchick is cited by the Examiner to provide teachings for the limitation added in claim 14. Kotchick teaches a method for fabricating a monolithic solid oxide fuel cell. Kotchick, however, does not teach the use of heat and pressure to form the sintered structure of a sheet or tape.

In view of the foregoing arguments, Applicants submit that Minh-I and Kotchick do not teach all of the limitations of claim 13. Claim 14, which depends from claim 13, is not rendered obvious over the cited references. Applicants therefore request that the 35 U.S.C. §103(a) rejection of claim 14 be withdrawn.

IX. Claim Rejections over McPheeters in view of Minh-I

Claims 1, 8, 13, 15, 16, 19 and 23 are rejected under 35 U.S.C. §103(a) as being unpatentable over McPheeters in view of Minh-I. (Office Action, page 7). Applicants respectfully traverse this rejection.

Applicants submit that McPheeters and Minh-I, alone or in any reasonable combination do not teach “*hot pressing the laminated structure using a combination of heat and pressure to form the interconnector component that contains chromium,*” as recited in claim 1, and “*applying heat and pressure to sinter the sheet to form the interconnector component that contains chromium,*” as recited in claim 13.

The Examiner recognizes that McPheeters does not teach this feature. (Office Action, page 7). The Examiner alleges that Minh-I teaches this feature at column 8, lines 41-42. (Office Action, page 8). As discussed above, Minh-I does not teach hot pressing using a combination of heat and pressure to form an interconnector element for an electrochemical converter.

In view of the foregoing arguments, Applicants submit that McPheeters and Minh-I, alone or in any reasonable combination, do not teach all of the features of claims 1 and 13. Claims 8, 15, 16, 19 and 23, which depend from one of claims 1 and 13, are not rendered obvious over the cited references. Applicants therefore request that the 35 U.S.C. §103(a) rejection of claims 1, 8, 13, 15, 16, 19 and 23 be withdrawn.

X. Claim Rejections over McPheeters in view of Kwon

Claims 1 and 8 are rejected under 35 U.S.C. §103(a) as being unpatentable over McPheeters in view of Kwon. (Office Action, page 8). Applicants respectfully traverse this rejection.

Applicants submit that McPheeters and Kwon, alone or in any reasonable combination, do not teach “*hot pressing the laminated structure using a combination of heat and pressure to form the interconnector component that contains chromium,*” as recited in claim 1.

The Examiner recognizes that McPheeters does not teach this feature. (Office Action, page 8). The Examiner refers to Kwon, paragraph [0035] as teaching this feature.

In paragraphs [0035], Kwon discloses a method for forming a fuel cell stack. Kwon also discloses that the fuel cell stack may be densified by sintering, such as hot pressing, hot forging. Kwon, however, does not disclose using hot pressing to form an interconnector component that contains chromium. In Kwon, hot pressing may be used to form a whole fuel cell stack. Kwon does not teach using hot pressing form a single component for an electrochemical converter, which contains chromium.

In view of the foregoing arguments, Applicants submit that McPheeters and Kwon, alone or in any reasonable combination, do not teach all of the features of claim 1. Claim 8, which depends from one of claim 1, is not rendered obvious over the cited references. Applicants therefore request that the 35 U.S.C. §103(a) rejection of claims 1 and 8 be withdrawn.

XI. Claim Rejections over Minh-I in view of JP 9-190829

Claims 9, 11 and 12 are rejected under 35 U.S.C. §103(a) as being unpatentable over Minh-I in view of JP 9-190829. (Office Action, page 9). Applicants respectfully traverse this rejection.

Independent claim 9 recites:

9. An interconnector component for an electrochemical converter comprising:
 - a first layer comprising a material having a composition that is at least 95% chromium; and
 - a second layer comprising lanthanum chromite laminated to the first layer, wherein the first layer and the second layer are hot pressed using a combination of heat and pressure to form the component.

Applicants respectfully submit that Minh-I and JP 9-190829, alone or in any reasonable combination, do not teach “**an interconnector component for an electrochemical converter,**” which includes a first layer of a material having a composition that is at least 95% chromium and a second layer of lanthanum chromite laminated to the first layer, as recited in claim 9.

Minh-I teaches interconnect material (33) sandwiched between anode material (30) and cathode material (32). Minh-I, however, does not teach an interconnector component for an electrochemical converter including a first layer of a material having a composition that is at least 95% chromium and a second layer of lanthanum chromite laminated to the first layer, as recited in claim 9.

JP 9-190829 teaches a separator (20) made of lanthanum chromite series ceramic. JP 9-190829 also teaches that the surface of the separator (20) facing the fuel gas passage is coated with a metal material layer (32) having a heat resistance and electroconductivity. JP 9-190829, however, does not teach the separator (20) includes a first layer of a material having a composition that is at least 95% chromium and a second layer of lanthanum chromite laminated to the first layer, as recited in claim 9.

The present application describes an exemplary embodiment of the interconnector component at page 9:

The high chromium composite core of the interconnector plate provides an impermeable separator for the electrochemical converter stack. The lanthanum chromite surface layer provides protection against the loss of chromium from vaporization in the form of Cr_2O_3 in the oxidizer side of the electrochemical devices.

Minh-I and JP 9-190829 do not provide these advantages. The interconnector of claim 9 is not obvious over Minh-I in view of JP 9-190829. Claims 11 and 12, which depend from claim 9, are not rendered obvious over the cited references. Applicants therefore request that the 35 U.S.C. §103(a) rejection of claims 9, 11 and 12 be withdrawn.

XII. Claim Rejections over Cable in view of Minh-I

Claims 1, 2, 4, 9-11, 13, 15, 16, 22, 23, 25 and 27 are rejected under 35 U.S.C. §103(a) as being unpatentable over Cable in view of Minh-I. Applicants respectfully traverse this rejection.

Applicants respectfully submit that Cable and Minh-I, alone or in any reasonable combination, do not teach “*hot pressing the laminated structure using a combination of heat and pressure to form the interconnector component that contains chromium,*” as recited in claim 1, “*applying heat and pressure to sinter the sheet to form the interconnector component that contains chromium,*” as recited in claim 13, and “*applying heat and pressure to sinter the sheet to a thickness of less than about 0.03 inches to form an interconnector component that contains chromium,*” as recited in claim 27.

The Examiner recognizes that “Cable does not disclose applying pressure during co-firing (hot pressing).” (Office Action, page 10). The Examiner alleges that Minh-I teaches this feature. (Office Action, page 10). Applicants respectfully disagree. Applicants submit that Minh-I fails to compensate for the deficiencies of Cable. As discussed above, Minh-I does not teach the above features of claims 1, 13 and 27.

Therefore, Applicants submit that Cable and Minh-I, alone or in any reasonable combination, do not teach all of the features of claims 1, 13 and 27. Claims 2, 4, 9-11, 15, 16, 22, 23 and 25, which depend from one of claims 1 and 13, are not rendered obvious over the cited references. Applicants respectfully request that the 35 U.S.C. §103(a) rejection of claims 1, 2, 4, 6, 13-17, 23 and 25-27 be withdrawn.

XIII. Claim Rejections over Maricle in view of Minh-I

Claims 13-16, 19, 20, 22, 23 and 25-27 are rejected under 35 U.S.C. §103(a) as being unpatentable over Maricle in view of Minh-I. Applicants respectfully traverse this rejection.

Applicants respectfully submit that Maricle and Minh-I, alone or in any reasonable combination, do not teach “*applying heat and pressure to sinter the sheet to form the interconnector component that contains chromium,*” as recited in claim 13, and “*applying heat*

and pressure to sinter the sheet to a thickness of less than about 0.03 inches to form an interconnector component that contains chromium,” as recited in claim 27.

The Examiner recognizes that “Maricle does not disclose applying pressure during sintering of the interconnector plate (hot pressing).” (Office Action, page 11). The Examiner alleges that Minh-I teaches this feature. (Office Action, page 11). Applicants respectfully disagree. Applicants submit that Minh-I fails to compensate for the deficiencies of Maricle. As discussed above, Minh-I does not teach the above features of claims 13 and 27.

Therefore, Applicants submit that Maricle and Minh-I, alone or in any reasonable combination, do not teach all of the features of claims 13 and 27. Claims 14-16, 19, 20, 22, 23 and 25-26, which depend from claim 13, are not rendered obvious over the cited references. Applicants respectfully request that the 35 U.S.C. §103(a) rejection of claims 13-16, 19, 20, 22, 23 and 25-27 be withdrawn.

XIV. New Claims

Applicants add new claims 28 and 29 to depend from claim 1. Claim 28 recites that the pressure is in a range of about 1000 psi. Claim 28 recites that a temperature of the heat is in a range of about 1300°C. In view of the arguments set forth above, Applicants submit that the new claims recite subject matter that is distinct over the cited references. Therefore, Applicants respectfully request that the Examiner pass the claims to allowance.

XV. Conclusion

In view of the above amendment, applicant believes the pending application is in condition for allowance.

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